Stoller
Grand Junction Office established 1959

GJO-2004-552-TAC

C4304
Log Data Report

Borehole Information:

Borehole: C4304			Site: 216-B-58 Trench		
Coordinates (WA St Plane)		GWL[1] (ft): None		GWL Date: 12/10/03	
North	East	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
Not available	Not available	12/03	Not available	100	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Welded steel	1. 5	8 11/16	7 5/8	17/32	+1.5	100
Unknown	0.9	10 3/4	9 5/16	23/32	+0.9	30

Borehole Notes:

The logging engineer measured the casing stickup using a steel tape. A caliper was used to measure the outside casing diameters. The caliper and inside casing diameters were measured using a steel tape. Measurements are rounded to the nearest 1/16 in. Casing thickness was calculated. Ground level elevation and coordinates were not available. Logging data acquisition is referenced to the ground surface.

Spectral Gamma Logging System (SGLS) Equipment Information:

Logging System:	Gamma 1G		Type:	SGLS (35%) SN: 34TP10967A
Calibration Date:	04/03	Calibration Reference:	GJO-2003-438-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

High Rate Logging System (HRLS) Equipment Information:

Logging System:	Gamma 1C		Type:	HRLS SN: 39-A314
Calibration Date:	04/03	Calibration Reference:	GJO-2003-429-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Neutron Moisture Logging System (NMLS) Equipment Information:

Logging System:	Gamma 2F		Type:	NMLS SN: H380932510
Calibration Date:	09/03	Calibration Reference:	GJO-2003-520-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2 Repeat	7	8 Repeat	
Date	12/23/03	12/23/03	12/30/03	12/30/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	99.0	37.0	28.0	20.0	
Finish Depth (ft)	30.0	30.0	1.0	16.0	
Count Time (sec)	200	200	200	200	
Live/Real	R	R	R	R	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	1.0	1.0	1.0	1.0	
ft/min	N/A[2]	N/A	N/A	N/A	
Pre-Verification	AG039CAB	AG039CAB	AG040CAB	AG040CAB	
Start File	AG039000	AG039070	AG040000	AG040028	
Finish File	AG039069	AG039077	AG040027	AG040032	
Post-Verification	AG039CAA	AG039CAA	AG040CAA	AG040CAA	
Depth Return Error (in.)	N/A	-1	0	0	
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	

High Rate Logging System (HRLS) Log Run Information:

Log Run	9	10 Repeat			
Date	12/30/03	12/30/03			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	13.0	12.0			
Finish Depth (ft)	9.0	11.0			
Count Time (sec)	300	300			
Live/Real	R	R			
Shield (Y/N)	N	N			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A	N/A			
Pre-Verification	AC087CAB	AC087CAB			
Start File	AC087000	AC087005			
Finish File	AC087004	AC087006			
Post-Verification	AC087CAA	AC087CAA			
Depth Return Error (in.)	N/A	0			
Comments	No fine-gain adjustment.	No fine-gain adjustment.			

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	3	4 Repeat	5	6 Repeat	
Date	12/23/03	12/23/03	12/30/03	12/30/03	
Logging Engineer	Spatz	Spatz	Spatz	Spatz	
Start Depth (ft)	30.0	30.0	0.0	10.0	
Finish Depth (ft)	99.0	37.0	28.5	15.0	
Count Time (sec)	N/A	N/A	N/A	N/A	
Live/Real	N/A	N/A	N/A	N/A	
Shield (Y/N)	N	N	N	N	
MSA Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1	1	1	1	
Pre-Verification	BF139CAB	BF139CAB	BF140CAB	BF140CAB	
Start File	BF139000	BF139277	BF140000	BF140115	
Finish File	BF139276	BF139305	BF140114	BF140135	

Log Run	3	4 Repeat	5	6 Repeat	
Post-Verification	BF139CAA	BF139CAA	BF140CAA	BF140CAA	
Depth Return Error (in.)	N/A	0	N/A	N/A	
Comments	None	None	None	None	

Logging Operation Notes:

Logging was performed in this borehole on December 23 and 30, 2003. Ten log runs were performed with three separate logging systems. These systems are referred to as SGLS 1G (4 log runs), NMLS 2F (4), and HRLS 1C (2). Measurements were acquired with each system in a single casing string (8-in.) from 30 ft to total depth of the borehole. The 8-in. casing was removed from the borehole and logging was conducted with each system from 0 to 28 ft in the remaining 10-in. casing. After retracting the 8-in. casing from the borehole, the maximum depth achieved was 28 ft. Logging was conducted with a centralizer on each sonde. Measurements are referenced to ground surface. Repeat sections were collected in this borehole for all systems to evaluate the logging system's performance.

Analysis Notes:

Analyst:	Henwood	Date:	01/5/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the logging systems were performed before and after data acquisition. Acceptance criteria were met for all systems.

A casing correction for 0.5313-in.-thick casing (8-in. casing) was applied to the spectral log data (SGLS and HRLS) from 30 to 99 ft. From 0 to 28 ft, a correction for 0.7188-in.-thick casing (10-in. casing) was applied. No correction for 10-in. casing is available for the NMLS. Consequently, moisture data are presented in counts per second and reflect relative moisture content.

SGLS and HRLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G1GMay03.xls and G1CApr03.xls for the HRLS using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent. Where SGLS dead time exceeds 40 percent, HRLS data were acquired. However, no meaningful energy peaks existed in the high rate spectra because the range of concentrations were below the system's detection limit. Correction for water was not needed in this borehole.

NMLS data were also processed in batch mode and volumetric moisture was calculated in an EXCEL worksheet using calibration data.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs and ^{60}Co) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. Neutron moisture log plots are provided that present volumetric percent moisture content for data acquired in the 8-in. casing from 30 to 100 ft and relative moisture content for the entire borehole in counts per second. Repeat log sections are also included where appropriate.

Results and Interpretations:

^{137}Cs was detected in this borehole between 3 and 14 ft. The maximum concentration of approximately 943 pCi/g was measured at 10 ft in depth. ^{60}Co was detected between 7 and 34 ft. A maximum ^{60}Co concentration of approximately 1,655 pCi/g was measured at 11 ft in depth.

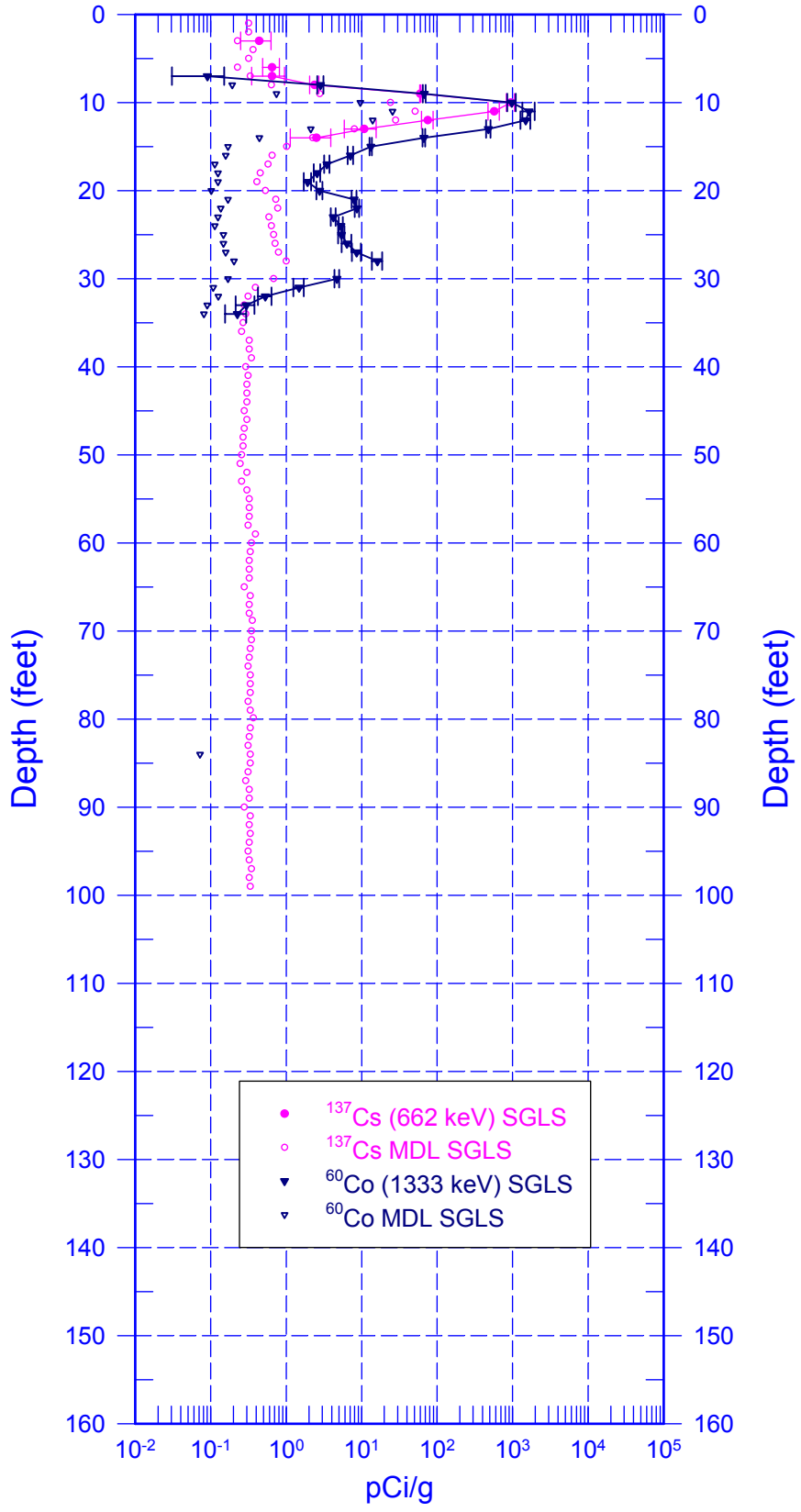
The repeat sections for the SGLS and NMLS indicate good agreement.

---

[1] GWL – groundwater level
[2] N/A – not applicable

C4304

Man-Made Radionuclides

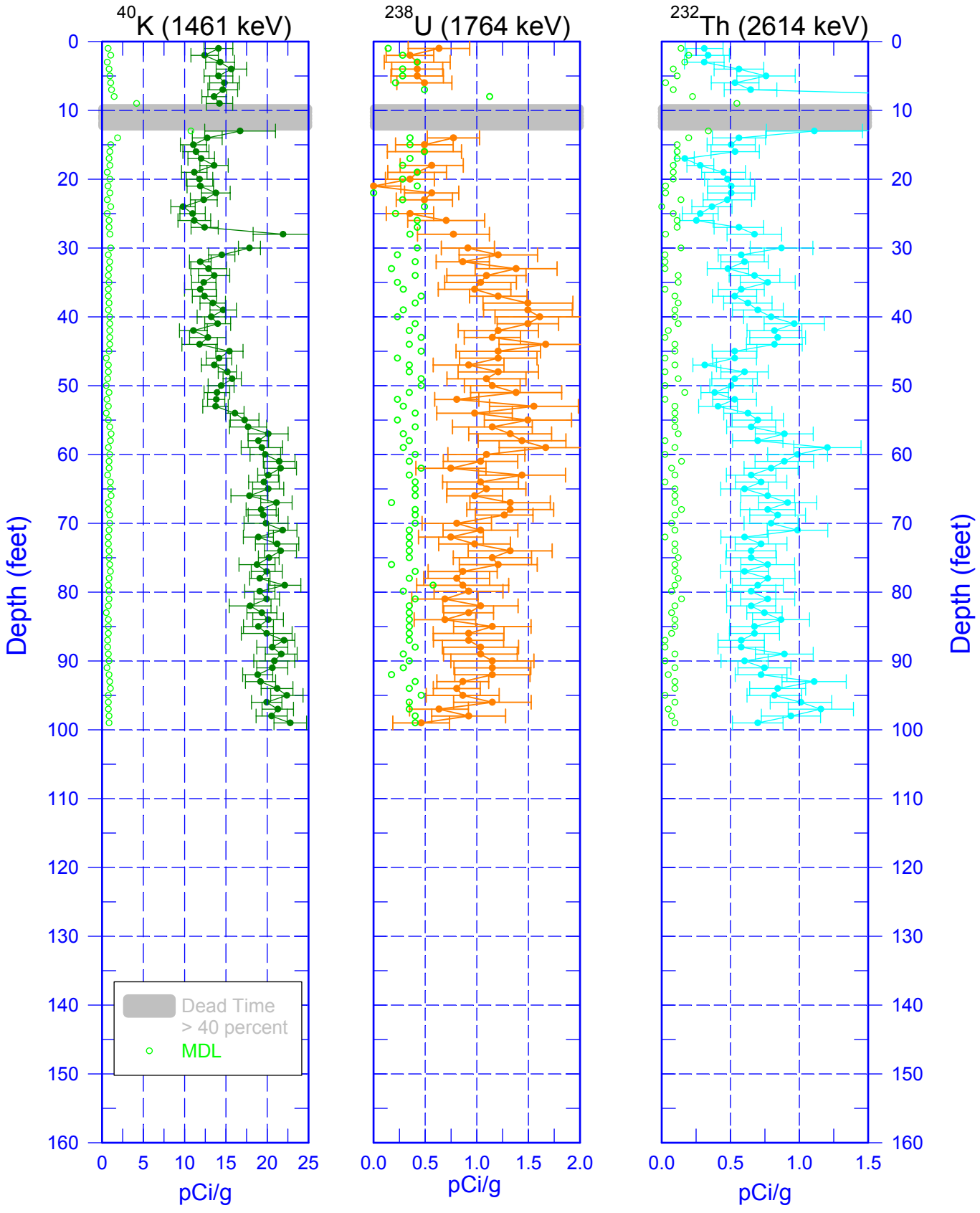


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 12/30/03

C4304
Natural Gamma Logs

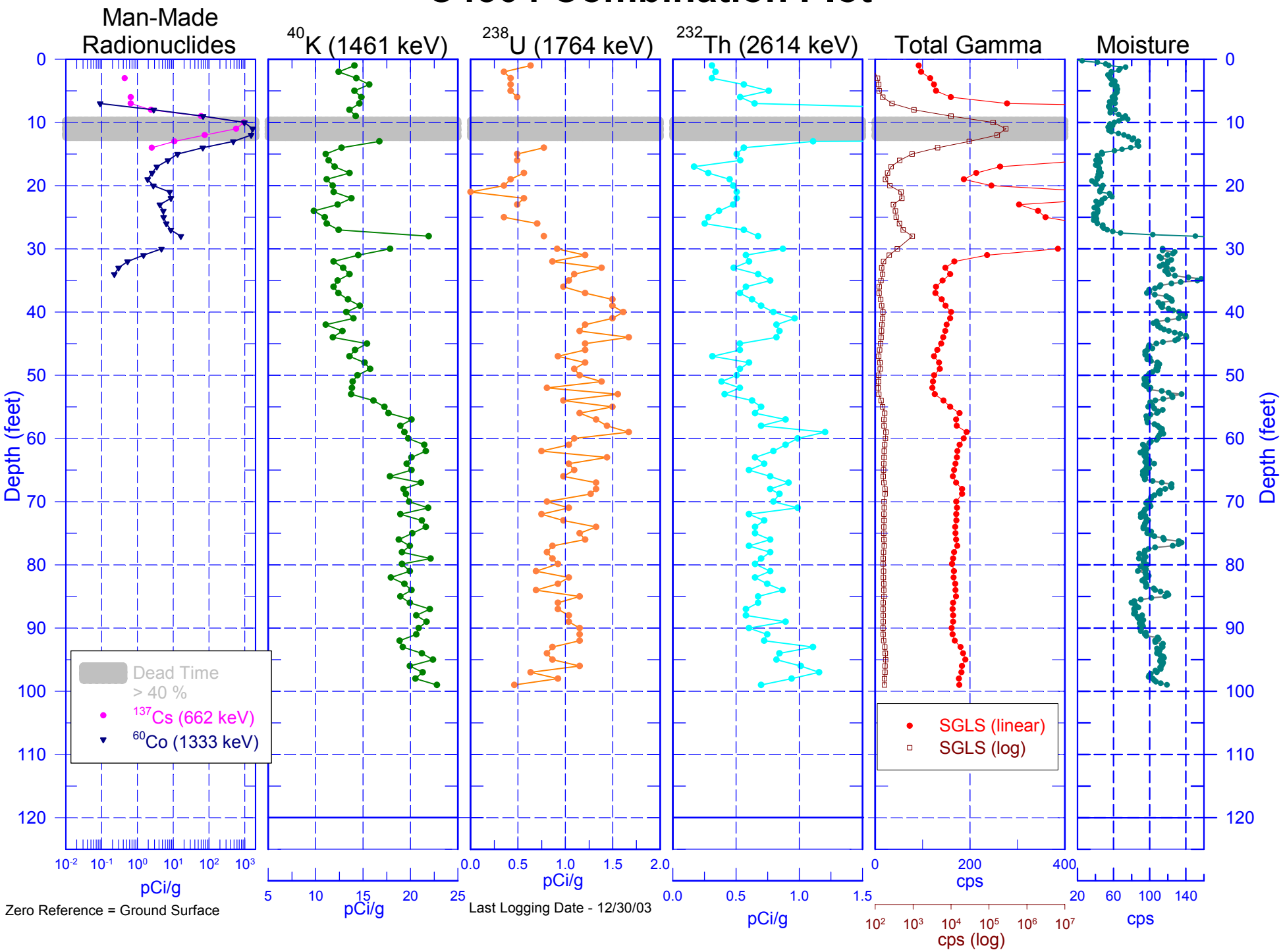


Zero Reference = Ground Surface

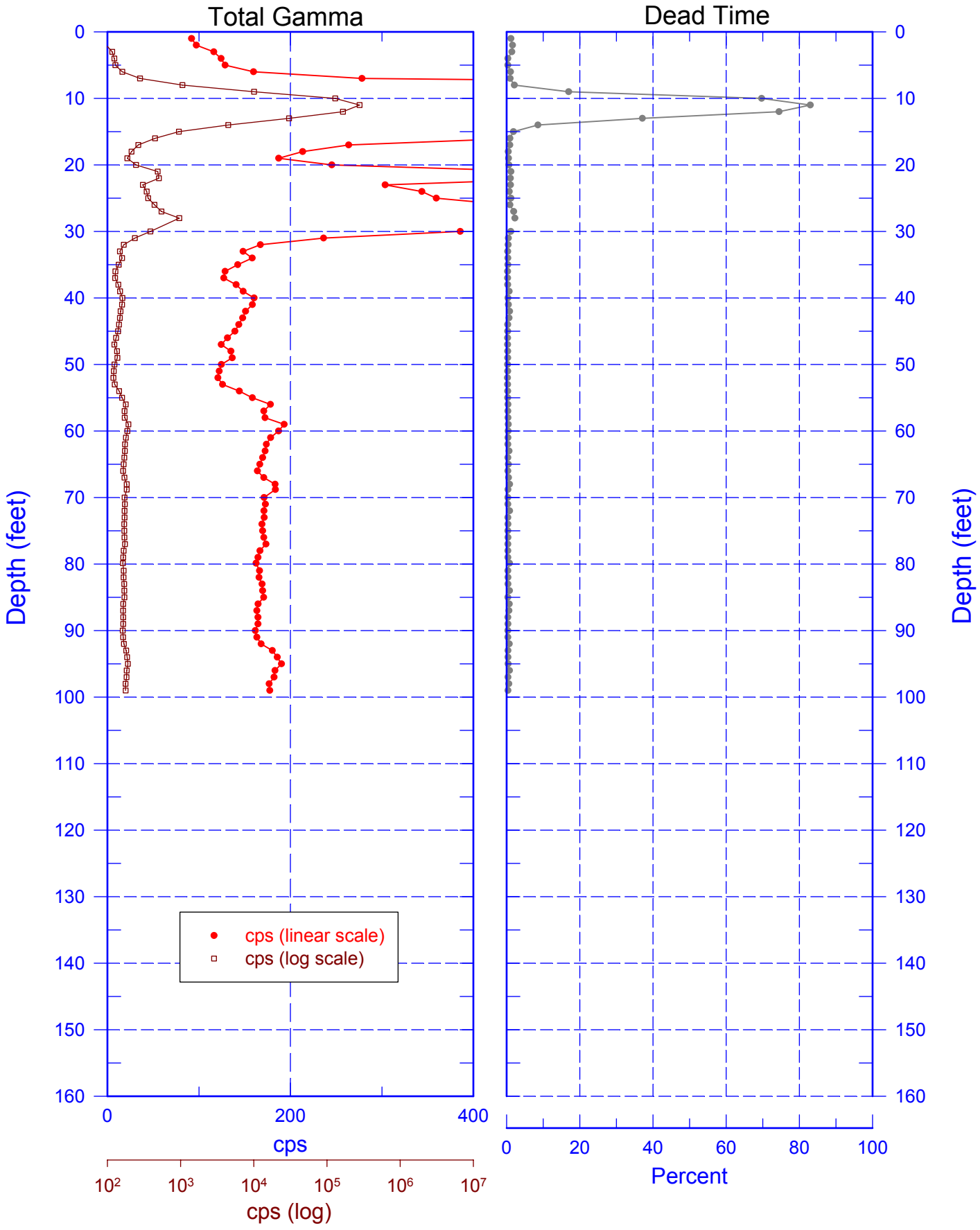
Depth scale: 1" = 20 ft

Last Log Date - 12/30/03

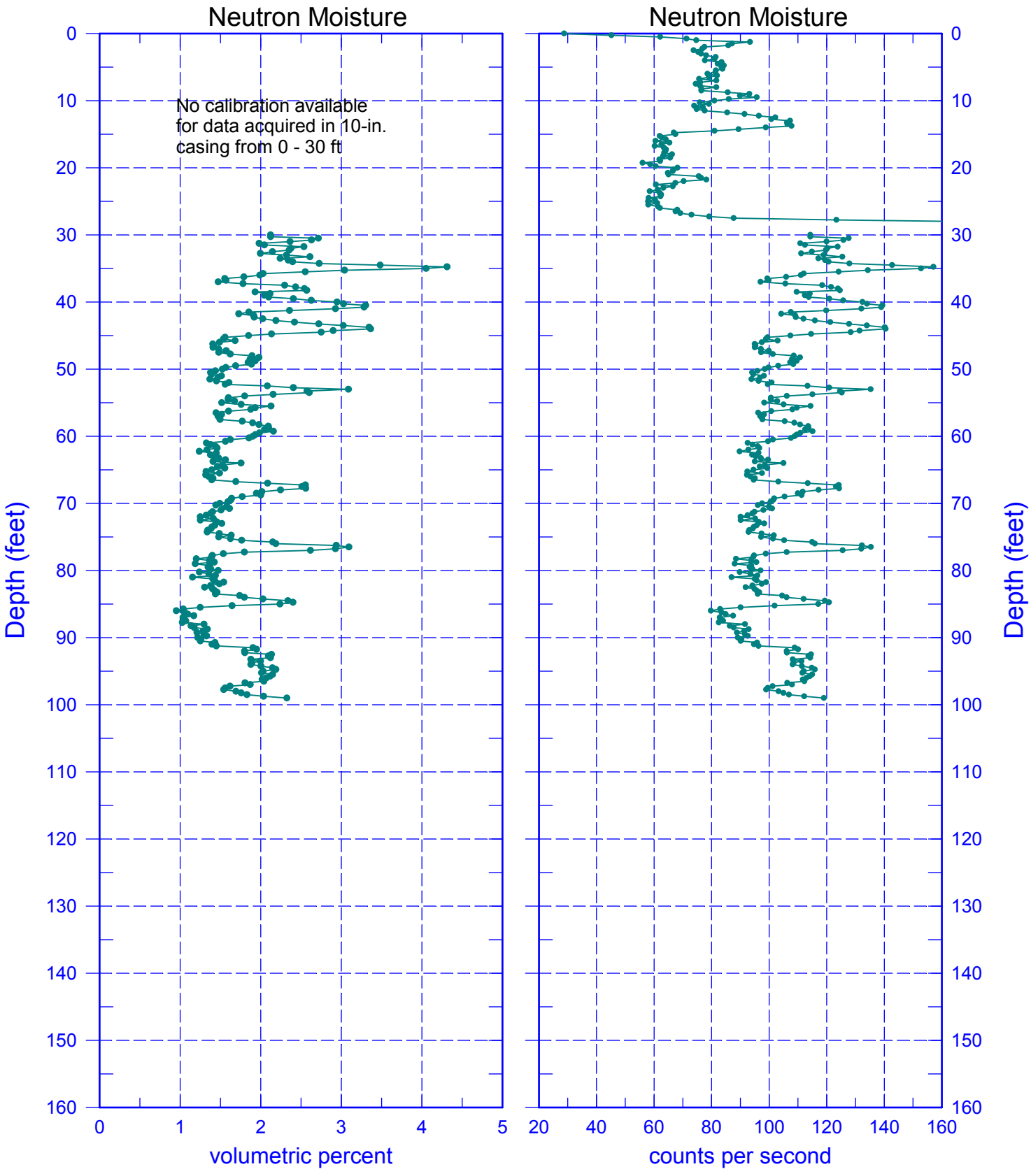
C4304 Combination Plot



C4304
Total Gamma & Dead Time



C4304



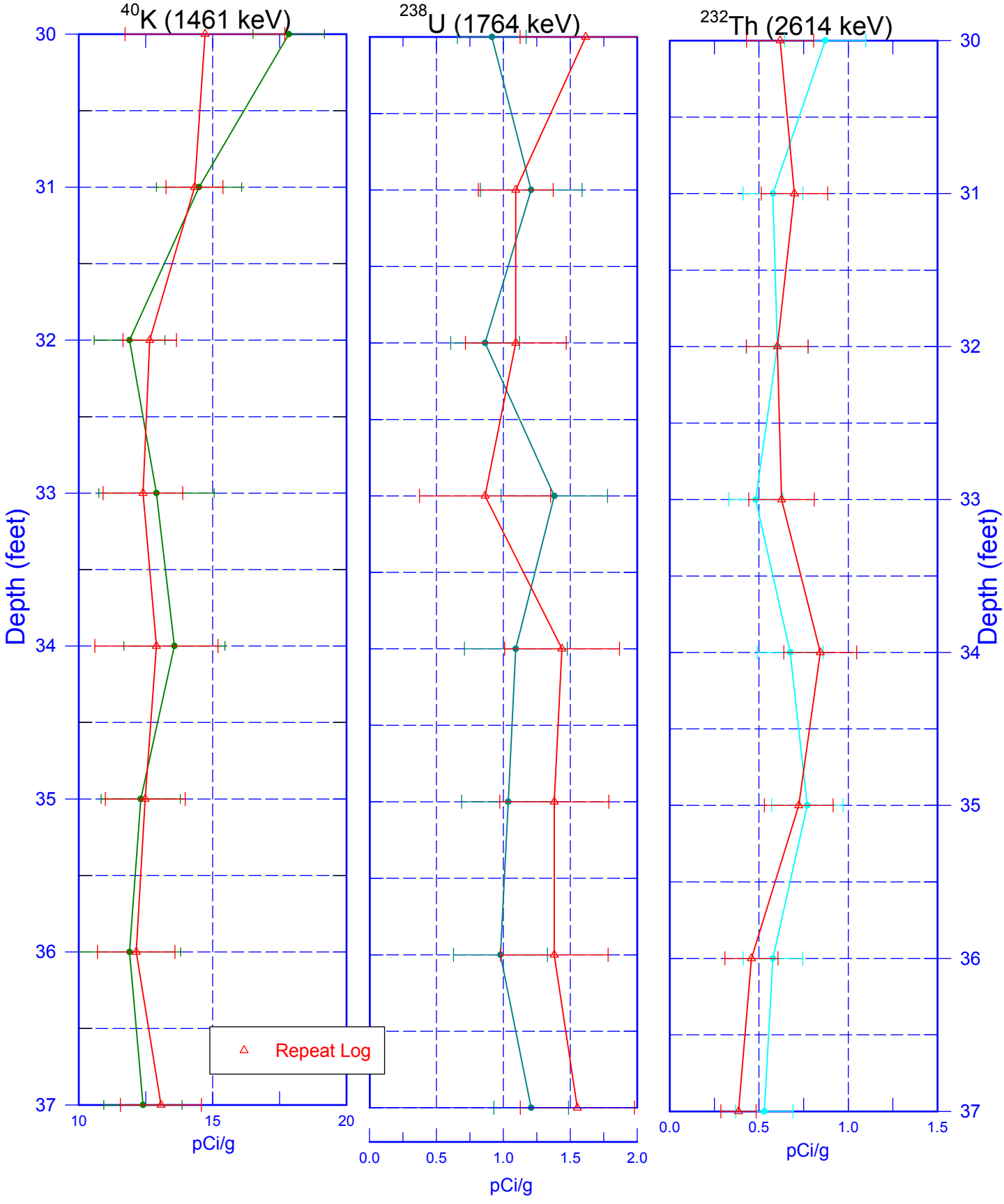
Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 12/30/03

C4304

Repeat Section of Natural Gamma Logs

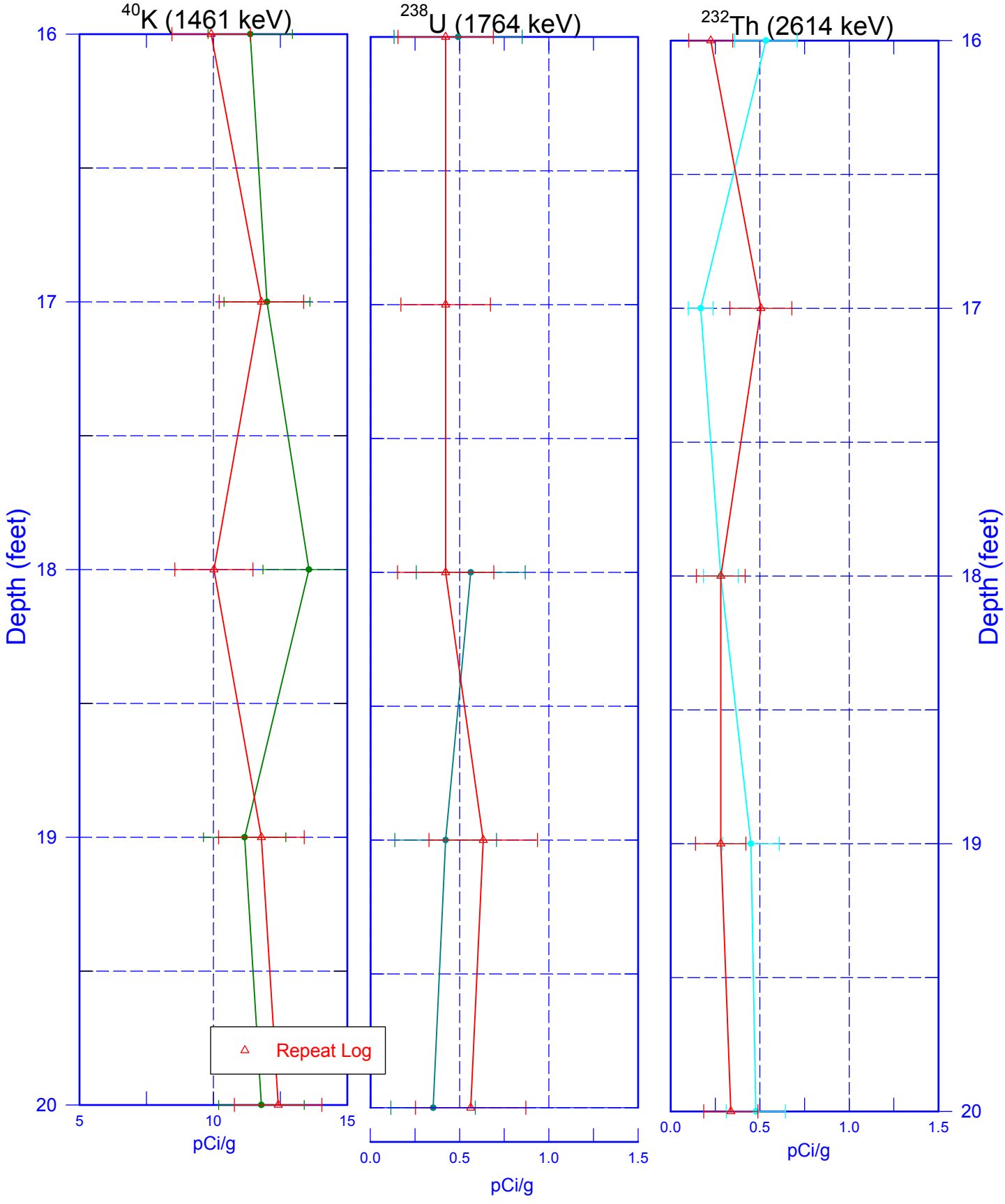


Zero Reference = Ground Surface

Last Log Date - 12/30/03

C4304

Repeat Section of Natural Gamma Logs

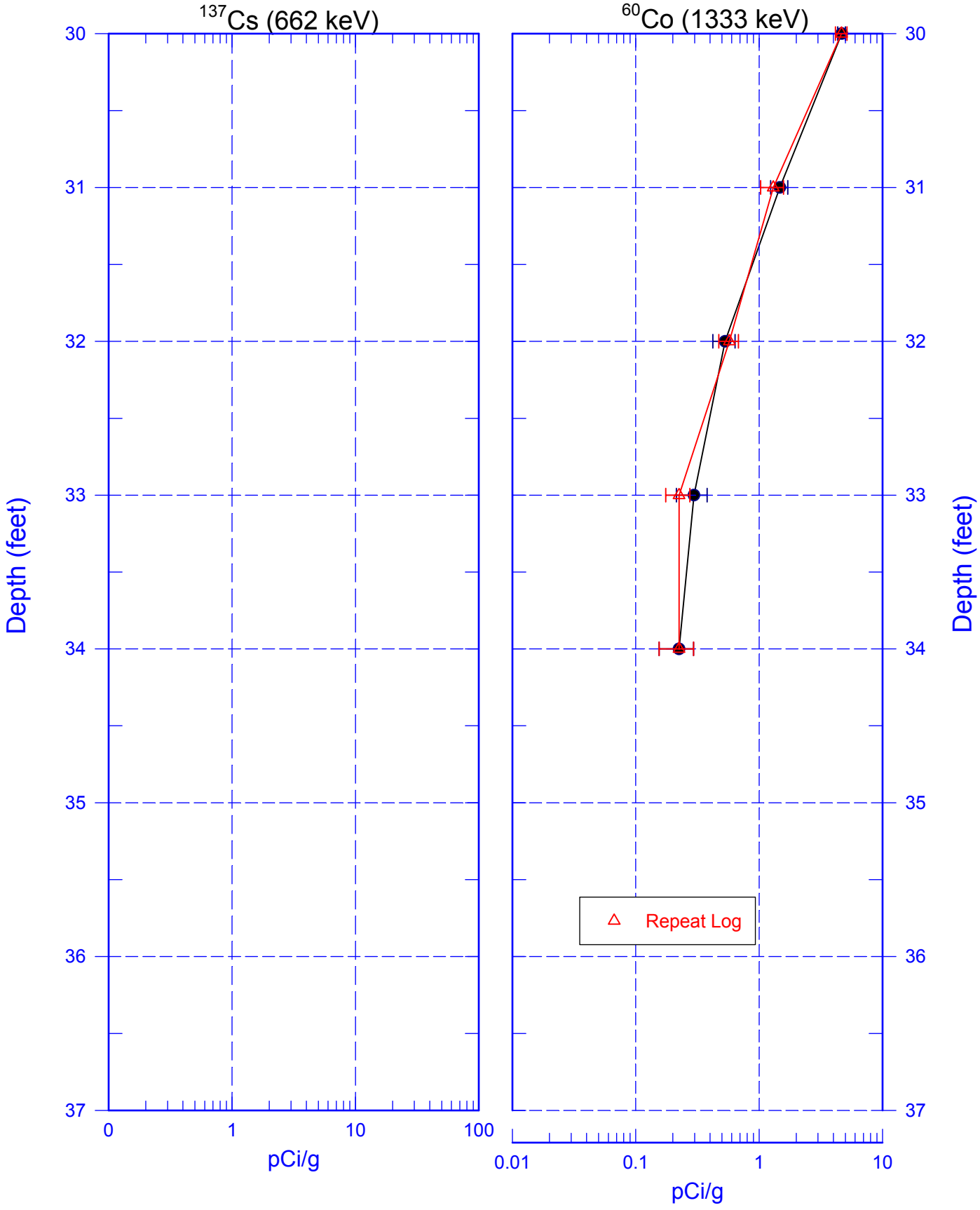


Zero Reference = Ground Surface

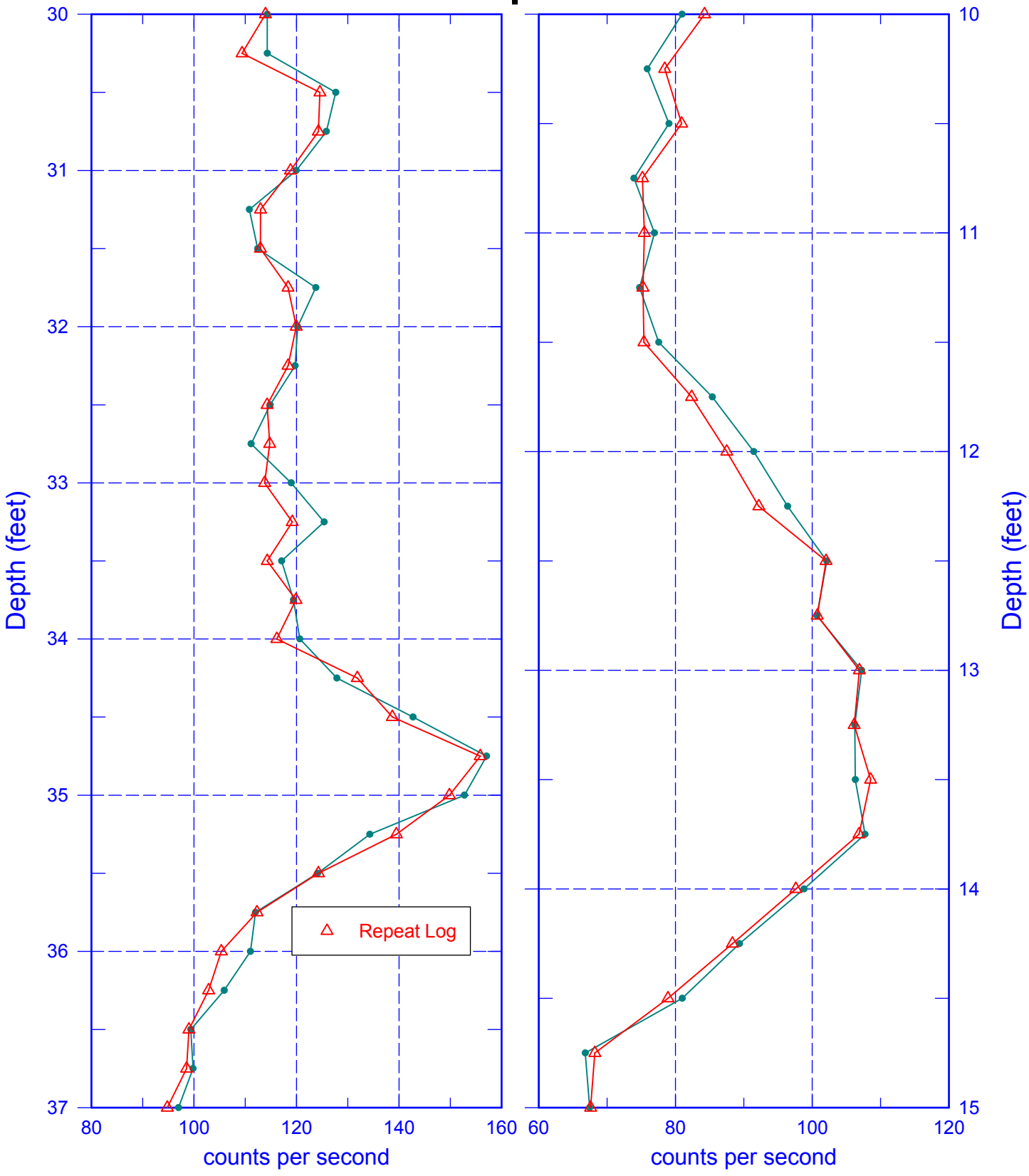
Last Log Date - 12/30/03

C4304

Repeat Section for Man-Made Radionuclides



C4304
Moisture Repeat Sections



Zero Reference = Ground Surface

Last Log Date - 12/30/03